

# MAIB

## MARINE ACCIDENT INVESTIGATION BRANCH VOYAGE DATA RECORDERS IN MARINE ACCIDENT INVESTIGATIONS

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### INTRODUCTION

Data recorders are now commonplace in many forms of transport and have made a substantial contribution to the understanding of accident causes and the improvement of safety.

Recorded data has enabled accident investigators to reconstruct events to identify precisely what went wrong and to ensure that effective, rather than convenient, recommendations can be made to prevent the same thing happening again. While many transport modes recognize the value of such devices, sections of the marine community have yet to be convinced. This reluctance to accept the value of data recorders and take positive measures to fit them in merchant vessels is, in the opinion of the authors of this paper, a contributory factor to the poor safety record of some ship owners today.

This paper not only argues the case for Voyage Data Recorders (VDRs) but gives examples of rudimentary data recordings that have made significant differences to the quality of United Kingdom marine accident investigations. There is no doubt that they have not only led to a much greater understanding of what actually occurred in each case but have done much to, arguably, ensure that the correct lessons are being learned.

### THE CASE FOR VOYAGE DATA RECORDERS

#### BACKGROUND

The air transport industry has led the way with data recorders. The mandatory fitting of flight deck recorders and cockpit voice recorders in most commercial aircraft has made a major impact to the improvement of safety in the air. This paper makes no attempt to rehearse the benefits; the results are clear to all and, when something goes wrong, the air accident investigator's task is made much easier.

Although there are some features that are common to both the air and sea transport industries, there are significant differences. Flights are measured in hours, voyages in days or even weeks. A ship can sink without anyone being aware of it for several days. Integrating a data recorder in the compact environment of an aircraft is one thing, fitting it into a merchant vessel is something entirely different, and the costs of so doing can be great. In a very competitive and loosely structured international industry there are many who see little or no commercial advantage to fitting them.

The safety record of some ship owners and flag states is far from satisfactory. In the past ten years about 1000 merchant ships have been lost and many more have been involved in lesser accidents to varying degrees. The human toll has been equally horrifying. Shipping, perhaps more than any other industry, is influenced by the realities of the market place with well run, properly manned,

modern vessels having to compete with badly maintained, poorly managed, indifferently crewed vessels of excessive age. The well run ship with its greater investment in training and safety is often at a commercial disadvantage when compared with a vessel at the other end of the spectrum where such matters are barely a consideration and the operating costs are consequently less.

Accidents can, and do, occur to vessels in any category and sailing under any flag. Leading flag states go to great lengths to establish the causes by fully investigating the circumstances and promulgating the findings for the benefit of all. States with independent accident investigation organizations are recognized as being the most effective in view of their impartiality and the trend towards making marine accident reports public. Many nations, despite having large parts of the world's fleet sailing under their flags, do little to fulfill the international requirement to investigate marine accidents when they occur. If an investigation is carried out there is, too often, little or no attempt to publish the report and any contribution to improving safety at sea is lost.

Marine accident investigation is all about reconstructing events. Unlike aviation where access to data recorders can provide answers to complex questions and establish patterns of human behaviour, the marine accident investigator has to rely much more on physical evidence and, crucially, the recollections of those involved. Occasions arise when there is nobody alive to tell the tale and the process of reconstruction becomes even more difficult. Ships sink, sometimes without trace.

This paper makes no attempt to argue for more independent and open marine accident investigations but it does advocate the early introduction of data recorders. Such devices will ensure that a true account of what occurred in an accident can be obtained. that appropriate recommendations are made and important lessons can be learned. They will also add greatly to an understanding of human factors at sea.

## THE CURRENT POSITION

The case for fitting VDRs in ships has been made. In July 1997 the Safety of Navigation Sub-Committee of the International Maritime Organization (IMO) approved draft standards for shipborne VDRs although, crucially, agreement has yet to be reached on which ships must carry the recorders and when. The European Community has acted ahead of the IMO requirements to ensure that all passenger ferries operating in Europe are equipped with VDRs to IMO standards.

This is just a start but, if in future, VDRs are to be carried by substantially more ships, agreement must be reached in the IMO on carriage requirements and on the text of a suitable amendment to the International Safety of Life at Sea (SOLAS) Convention.

Within the IMO there is disagreement at present. Some flag states do not want VDRs at all while others argue that a trial period is needed. This latter position is seen as a delaying tactic and an excuse to have the entire idea put to one side for the foreseeable future. On the other hand, there are others, mostly North American, Western European and Australasian flag states, that want their rapid and complete introduction to increase safety and environmental protection around their coasts.

There are also disagreements among shipowners. A small minority need no convincing of their value and have voluntarily fitted VDRs to their vessels. Others recognize their potential as a safety tool but are concerned that having borne the high cost of installation there will be no commercial benefit while a third group, probably the majority, will resist their introduction whatever the circumstances. Those in the third category will raise various arguments to prevent their introduction and frequently cite the lack of any clear evidence that they will improve safety or offer a competitive advantage. Vessels fitted with VDRs have, arguably, a better safety awareness and record but this seemingly does not attract any commercial benefit

The United Kingdom's Marine Accident Investigation Branch (MAIB) knows there are significant advantages to having access to data recorders both onboard and ashore. There is growing evidence to show that events can be

reconstructed far more accurately than is ever possible without them. It has also meant that the primary and underlying causes of accidents can be identified with far greater certainty, and with less argument from anyone wishing to protect their own, or client's, interests.

## MARINE ACCIDENT INVESTIGATION LIMITATIONS

Specialist marine accident investigation is still a relatively new science. It relies extensively on being able to interview witnesses and the gathering of evidence on a slightly ad hoc basis.

Despite substantial improvements with interviewing techniques, the human memory is fallible. Even the most co-operative of witnesses will forget crucial events and will have difficulty in recalling precise times. Most witnesses do their best to remember events but there will be many gaps in the information they can provide. They also tend to be more cautious with what they reveal if company lawyers are present during the interview.

As witness statements are often the most important factors in the collection of evidence, conclusions invariably have to be drawn from what they say even though the information derived is often incomplete and in conflict with that derived from other sources. Although it is possible to carry out a good investigation using traditional techniques, there are too many occasions when the conclusions lack robustness or those with vested interests may exercise whatever influence they can to have their point of view presented in a more favourable light. It is not unknown for the true causes and underlying factors to be ignored in a final report and the blame for whatever occurred to be conveniently placed on anyone who has died in the accident.

Whenever the evidence is inconclusive the issues will be clouded. Too often in the past the causes of the accident have not been accurately identified and too little has been done to improve matters. The practice can lead to unsafe practices being condoned or remedial measures not being introduced for want of firm evidence. An officer or a pilot is conveniently "found" to have been at fault with

"human error" cited as the reason, but the lack of hard evidence allows for neither a robust criticism nor an effective defence of the finding. This is very unsatisfactory for all concerned. The lessons from such accidents are frequently ignored and the underlying causes, often involving those not directly involved in the actual incident, are never promulgated.

## EXAMPLES OF UK ACCIDENTS WHERE DATA RECORDING WAS NOT AVAILABLE

### *Zulfica/Wilhelmina J*

In 1991 the Cypriot registered cargo ship *Zulfika* collided with the British fishing vessel *Wilhelmina J* causing the capsizing and loss of the fishing vessel with the lives of all six of her crew. The MAIB's investigation into this tragedy found that because there had been no survivors from *Wilhelmina J*, a degree of supposition had been necessary concerning her precise movements. The inspectors had, nonetheless, concluded that among other things the master on *Zulfika* had been seriously at fault in the management of his vessel by not stopping and reporting the accident to the coastal authorities until some two hours after the event. The master was subsequently tried in a Cypriot court of law on charges arising from the accident. Although he was acquitted on all counts, his reputation was tarnished and suspicion still surrounds his actions.

Had either vessel been fitted with a VDR, a more reliable reconstruction of events would have been possible and enabled a safe conclusion to be reached.

### *Flag Theofano*

In 1990 the Greek registered bulk carrier *Flag Theofano* sank in 20 metres water depth with the loss of all nineteen persons on board. She was carrying a cargo of 3920 tonnes of cement and was only three miles from her intended destination anchorage when the accident occurred. It was blowing force 8 and a rough sea was running at the time.

The investigation concluded that she probably capsized following a cargo shift. The precise

cause could not be ascertained but a judgement was made that heavy rolling had been induced by a possible propulsion break down or a steering failure. With no survivors or witnesses it was impossible to be more precise. As forty nine other cement carriers had foundered in the previous ten years, the IMO took swift and effective action to limit the size of cement cargoes and their ability to shift. However, with the families' of the lost crew members demanding someone to blame, criticism was inevitably directed at the master for sailing from the loading port when severe weather was forecast.

A VDR would have enabled a far more accurate, not to say fairer, means of investigating the accident.

### ***Hero/Larrissa***

In 1994 the Maltese registered cargo ship *Hero* collided with, and sank, the British fishing vessel *Larrissa*. All six crew of the *Larrissa* were lost and accident investigators were unable to recreate the circumstances leading up to the collision. The only source of information on *Larrissa's* movements was that provided by the crew of the cargo ship and their evidence was scarcely credible. Had she been fitted with a VDR capable of recording radar information and the voices of those on the bridge, the actions of those involved would have been judged on fact rather than supposition.

### ***Derbyshire***

One of the world's largest vessels, the UK registered 170,500dwt bulk carrier *Derbyshire* sank with the loss of all 44 hands in the north west Pacific in September 1980. Nobody knew where she had gone down and speculation grew as to the reasons for her loss. Much of this focused on circumstantial evidence that she had foundered due to structural failure.

Pressure from the families of those who had lost their lives in the accident eventually led to an underwater search being carried out by the International Transport Workers' Federation in 1994. This found her lying in many pieces on the seabed at a depth of 4100 metres and prompted the British Government to carry out

a more comprehensive survey and analyze the findings. This has now been done and the matter is being referred to a re-opened Formal (Public) Inquiry in the UK. Leaving aside the arguments about what caused the *Derbyshire* to sink, the lengths to which it has proved necessary to establish the cause of loss, and the costs of so doing, have been, and are continuing to be, extensive. The provision of a VDR capable of floating free, or one capable of being recovered from the seabed, would have transformed the process of trying to establish the cause of her loss with savings in money, time and effort. Above all, it would have ensured that any lessons to emerge would have been known far more rapidly.

### **MAIB EXPERIENCE WITH RECORDED EVIDENCE**

A better system of being able to record events has long been advocated. A VDR records what actually happened, removes argument, and ensures that appropriate corrective measures can be taken. It is among the most valuable tools available to the marine accident investigator.

Data recorders are not necessarily confined to 'black boxes' on vessels. Most ships now carry a range of computer operated equipment. Much of it will have accessible memories or a means of recording data. The knowledgeable marine accident investigator is able to extract a wide range of information from onboard computers and can often reconstruct many events with the benefit of a common time standard.

Additionally, and increasingly, other sources of recorded data are becoming available including recorded radio channels, vessel traffic system (VTS) shore radars, closed circuit television and privately operated video cameras.

In recent years MAIB Inspectors have investigated accidents where some form of electronic system has independently recorded events as they have occurred. These have not only been very revealing but have clearly shown up the inadequacies of existing methods.

Without exception these electronic systems have shown up the limitations of the human's ability to accurately recall events. There have been a number of occasions where the 'evidence' of an apparently honest and reliable witness has been totally contradicted by a recording of a shore radar, vhf radio or, on one occasion, the ship's VDR and its ability to replay everything that was said on the bridge.

#### EXAMPLES OF UK ACCIDENTS WHERE DATA WAS RECORDED

In 1998 a vessel was holed while on passage in the River Thames. The vessel sank as a result of the grounding but all on board survived. When interviewed after the event both master and second officer were convinced they had been in mid channel when the accident occurred and had struck some floating debris. They were genuinely astonished to discover from the recording of the port authority's radar that their vessel had been outside the fairway for some time prior to grounding. Without this incontrovertible evidence doubt about the vessel's actual track would have remained in doubt.

In 1994 a VDR fitted cruise ship lost all propulsion and main electrical power seven miles off a lee shore. The wind was gusting force 8 and the vessel began to drift rapidly towards the nearest land. When interviewed after the event the master was sure he had been fully aware of the direction of the vessel's drift towards the shore and had reported this accurately to the coastguard. When the accident was investigated it transpired that he had actually informed the coastguard the vessel was drifting clear of the coast which led them to believe the risks involved were not great and that there was no need to activate the local area emergency plan. When faced with this 'fact' after the accident the master refused to believe it. It wasn't until he listened to the VDR bridge audio recording that he discovered his memory was at fault.

This incident gave MAIB inspectors their first experience investigating an accident in which a VDR had featured. Quite apart from providing a true record of what had occurred it was also their first real opportunity to compare evidence gathered in the traditional manner with accurate evidence from a recorder. The results

were not only surprising but demonstrated the very real shortcomings of traditional techniques.

It also provided a further insight into what actually happened on the bridge during the incident. The VDR's recorded radar information gave an accurate indication of the vessel's drift rate and direction. Interestingly it bore little resemblance to the positions plotted on the chart. It was then found that a single error in chartwork had initiated a chain of events that only became evident when listening to the VDR voice recordings of those on the bridge. The master had been given incorrect wind and tide information by his bridge team which explained why his report to the coastguard was inaccurate.

It would be unwise to draw too much from this one incident but the potential advantages of having a VDR were marked. What, in other circumstances might have been considered reliable evidence was shown to be inaccurate. It also became clear that evidence derived from a VDR can lead to a far better understanding of human factors at sea. This is still an area where much work needs to be done.

It is widely accepted that over 80% of all accidents can be attributed to human factors. These include fatigue, sleep deprivation, poor onboard communication, inadequate training, incompetence or inexperience, perceptual abilities, lack of teamwork, high workload, health, drugs and personal worries arising from domestic difficulties. Many sections of the marine industry have recognized this and are beginning to take action to improve matters. A growing understanding of the human factor element has enabled investigators to gain a clearer insight into the causes of human error but their efforts are often hampered by a lack of firm evidence and good information.

There have been several other recent incidents where electronically recorded data has played an important role in either the reconstruction of events or the drawing out of lessons to be learned. There is at least one very embarrassed fisherman in Britain who was dismayed to discover that a dockside security camera had faithfully recorded his boat capsizing while it was alongside, thus

demonstrating the inadequacies of his stability calculations. The pictures have made a telling impact on the fishing industry.

A cruise liner was leaving port with the pilot embarked, somewhat unusually, in a launch that proceeded her. An amateur cameraman videoed the departure and managed to capture the moment the liner went aground in vivid Technicolor. The interesting thing from the accident investigator's viewpoint was that the video camera also recorded everything the pilot said. Or to be more accurate it recorded what he didn't say. According to the information on the sound track the pilot had no idea the ship was just about to hit the only rock near the main channel!

Except when there has been a deliberate attempt to suppress, or distort evidence, such revelations are generally welcomed by those involved even though they may cause acute embarrassment. There is a natural reluctance of people to be so exposed but, providing a form of confidentiality or protection can be provided, and the results are used for the purpose of identifying causes, most people accept that such devices have the potential to lead to genuine improvements in safety.

## CONCLUSIONS

Marine accident investigators in the United Kingdom need no convincing of the importance of data recorders in ships and will argue for their introduction as soon as possible. They believe they will remove the many ambiguities and uncertainties that currently exist in accident investigations and will argue that their introduction will make a major contribution to marine safety.

The authors of this paper also believe that despite the undisputed benefits that arise from being able to investigate accidents more thoroughly, many in the marine community will continue to find little to persuade them that fitting VDRs will personally benefit them.

For VDRs to find universal favour there must be financial benefits from their carriage. A reduction in the costs of insurance or other charges for VDR fitted vessels would do more for their introduction than any amount of domestic or international regulations.